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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	02371.0003.US01
First Named Inventor or Application Identifier	Kenneth Margon
Title	System and Method for Single-Point to Fixed-Multipoint Data Communication
Express Mail Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents

ADDRESS TO: Assistant Commissioner for Patents
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Washington, DC 20231

1. ☐ *Fee Transmittal Form (Form PTO-1082)
   (Submit an original and a duplicate for fee processing)
2. ☒ Specification [*Total Pages* 20]
   (preferred arrangement set forth below)
   - Descriptive title of the Invention
   - Cross References to Related Applications
   - Statement Regarding Fed sponsored R&D
   - Reference to Microfiche Appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings (if filed)
   - Detailed Description
   - Claims
   - Abstract of the Disclosure
3. ☒ Drawing(s) *(35 USC 113)* [*Total Sheets* 5]
4. Oath or Declaration [*Total Pages*]
   a. ☐ Newly executed (original or copy)
   b. ☐ Copy from a prior application (37 CFR 1.63(d))
   (for continuation/divisional with Box 17 completed)
   [Note Box 5 below]
   i. ☐ DELETION OF INVENTOR(S)
   Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
5. ☐ Incorporation By Reference *(useable if Box 4b is checked)*
   The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. ☐ Microfiche Computer Program *(Appendix)*
7. Nucleotide and/or Amino Acid Sequence Submission
   (if applicable, all necessary)
   a. ☐ Computer Readable Copy
   b. ☐ Paper Copy (identical to computer copy)
   c. ☐ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. ☐ Assignment Papers (cover sheet & document(s))
9. ☐ 37 CFR 3.73(b) Statement *(when there is an assignee)* ☐ Power of Attorney
10. ☐ English Translation Document *(if applicable)*
11. ☐ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS Citations
12. ☐ Preliminary Amendment
13. ☒ Return Receipt Postcard (MPEP 503) (Two)
    (should be specifically itemized)
14. ☐ *Small Entity Statement(s) ☐ Statement filed in prior application, Status still proper and desired
15. ☐ Certified Copy of Priority Document(s)
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16. ☐ Other:

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17. **If a CONTINUING APPLICATION,** *check appropriate box and supply the requisite information.*
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PATENTS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: **Kenneth Margon**	Group Art Unit: To Be Assigned
Appl. No.: To Be Accorded	Examiner: To Be Assigned
Filed: January 13, 2000	Atty. Docket No.: 02371.0003.US01
For: **SYSTEM AND METHOD FOR SINGLE-POINT TO FIXED-MULTIPOINT DATA COMMUNICATION**	

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Sir:

The following documents are forwarded herewith for appropriate action by the U.S. Patent and Trademark Office:

1. U.S. Utility Patent Application entitled:

   SYSTEM AND METHOD FOR SINGLE-POINT TO FIXED-MULTIPOINT DATA COMMUNICATION

   and naming as inventor: **Kenneth Margon**

   the application comprising:

   a. A specification containing:

      (i) 12 pages of description prior to the claims;

      (ii) 7 pages of claims (**65** claims);

      (iii) a one (1) page abstract;

   b. 5 sheets of drawings: (Figures 1, 2A, 2B, 3, 4 and 5); and

2. Two (2) return postcards.

It is respectfully requested that, of the two attached postcards, one be stamped with the filing date of these documents and returned to our courier, and the other, prepaid postcard, be stamped with the filing date and unofficial application number and returned as soon as possible.

This patent application is being submitted under 37 C.F.R. § 1.53(b) without Declaration and without filing fee. This application claims priority under 35 U.S.C. § 119(e) to Provisional Application No. 60/118,662 filed January 14, 1999.

Respectfully submitted,

Cono A. Carrano
Attorney for Applicant
Registration No. 39,623

Enclosures

Dated: January 13, 2000

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SYSTEM AND METHOD FOR SINGLE-POINT TO FIXED-MULTIPOINT DATA COMMUNICATION

Inventor:* *Kenneth Margon

The present application claims priority under 35 U.S.C. § 119(e) to provisional application 60/118,662 filed on January 14, 1999, the entirety of which is incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to data communication, and more particularly, to a method and system for single-point to fixed-multipoint communication.

BACKGROUND OF THE INVENTION

In a conventional single-point to fixed-multipoint data communication system, a base station transmits to fixed remote stations and each of the fixed remote stations, in turn, transmit to the base station. Such systems typically use one or more predetermined and typically internationally adopted communication protocols. These protocols tend to be optimized for particular applications and industries. For example, protocols used for wireless communication tend to be developed and influenced by the telecommunication industry. However, since many of these conventional systems that have communication medium interconnecting the base station to the fixed remote stations are terrestrial (*e.g.*, copper or optical fiber medium) the data communication protocols tend to be developed and/or heavily influenced by the computer industry.

A fixed wireless system is generally characterized by a point to multipoint topology where remote stations are fixed at specific locations. Wireless in the Local Loop (WLL) is an example of a point to multipoint topology. Most WLL solutions use a variant one of the major wireless telecommunication protocols such as Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), or Code Division Multiple Access (CDMA). Systems using these protocols assign and reserve bandwidth for the communication between the remote stations and the base station.

A FDMA-based system assigns a separate channel in an available channel band to each remote station. For instance, in cellular systems these channels are assigned by the base station upon receiving a request for channel from a cellular phone (radio). There is a common channel used for control information that is passed back and forth between the base and remote. A TDMA-based system breaks a channel into time slots. Each remote station is assigned a time slot. If there is no data to be transmitted when the time slot becomes available, the bandwidth is wasted since it is not reallocated to another remote radio. In general, a CDMA-based system uses a non-correlating coding sequence to allow multiple radios to transmit and receive in the same frequency range. In cellular CDMA, a base station assigns a code based on a request from a cell phone. There is a practical limit to the number of codes in use in a sector, thus limiting the number of active channels.

Conventional wireless telecommunication protocols tend to be efficient where there is a continuous flow of information. However, Internet data traffic and modern voice digitizing technology is by its nature bursty in its use of bandwidth. Accordingly, systems using these conventional protocols do not make efficient use of the available channel bandwidth with the bursty data traffic, largely because the assigned channels remain idle whenever their assigned stations are not bursting.

Another drawback associated with existing wireless telecommunications protocols is that they require a base station to communicate and broker bandwidth among the remote stations which causes significant delays. Additionally, these conventional protocols fail to accommodate the various demands of different remote stations at different times because of their inability to dynamically allocate bandwidth based on traffic demand.

Conventional computer-based data communication protocols are typically designed and used for multipoint to multipoint communication. Such protocol are optimized to handle bursty data traffic. Examples of such protocols include Carrier Sense Multiple Access (CSMA) and Carrier Sense Multiple Access/Collision Detection (CSMA/CD) protocols. When optimized, these protocols can make efficient use of the bandwidth. The optimization, however, assumes the multipoint-to-multipoint underlying topology. In addition, because of the lack of channel reservations and due to the

inconsistency of burstiness of data traffic, these protocols fail to adequately support time sensitive data traffic, such as digitized voice, at high utilization rate of their bandwidth.

SUMMARY OF THE INVENTION

The present invention is directed to systems and methods for efficient single-point to fixed-multipoint data (data and/or digitized voice) communication. The invention overcomes the drawbacks of conventional systems and protocols, particularly with respect to applications with bursty or time sensitive data traffic, by dynamically allocating bandwidth based on traffic demands.

In one embodiment, wireless data communication is provided in context of Internet Protocol Multiple Access (IPMA) system having a Base Station and a plurality of Remote Stations. In operation, the Base Station transmits data packets to the Remote Stations via a Forward Channel and the Remote Stations transmit data packets to the Base Station. Before transmitting on the Reverse Channel, each of the Remote Stations listens to (monitors) the Reverse Channel to ascertain whether any other Remote Station is transmitting. Remote Stations transmit data only when a Remote Station determines that the channel is clear. The Remote Stations listen in sequential order, eliminating the probability of collisions caused by simultaneous transmissions from Remote Stations.

The invention also efficiently and dynamically aggregates data traffic, thus allowing the entire bandwidth to be utilized. For example, when only one of Remote Stations requires bandwidth, the entire bandwidth is allocated to that Remote station. If multiple Remote Stations need bandwidth, the entire bandwidth is allocated according to the needs of those stations. No Remote Station is denied bandwidth nor is bandwidth wasted on a Remote Station that has no data to send with the teaching of the invention. Furthermore, use of the Reverse Channel is achieved without the overhead of brokering, thereby circumventing and associated delays.

Another feature of the invention is that the order in which the Remote Stations listen to the Reverse Channel can be rotated periodically. Thus, equal access for transmission on the Reverse channel is ensured for all Remote Stations.

In another aspect of the invention, Remote Stations are assigned to various zones. Remote Stations in a given zone listen only to other Remote Stations in that zone. This

reduces the hardware cost associated with Remote Stations since zones can be configured for those stations within a close geographical proximity of each other. Alternately, Remote Stations can be grouped in zones based on station type, data traffic type, or access rate requirements for the Reverse Channel.

Another advantage of the invention is that constraints on distance from the Base Station are removed. For example, embodiments of the invention allow communication over wireless distances in excess of 50Km from a Base Station in 2 GHz bands.

In addition, embodiments of the invention are more efficient than CDMA. For example, if CDMA cellular system carries 30 simultaneous phone conversations in one cell sector, the invention can carry 240 simultaneous phone conversations using only one correlating code.

The foregoing, and other features and advantages of the invention, will be apparent from the following, more particular description of the preferred embodiments of the invention, the accompanying drawings, and the appended claims.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

Figure 1 is a topological view of a single-point to fixed-multipoint wireless data communication system in accordance with the invention.

Figures 2A and 2B, respectively, are high level views of a half-duplex and a full-duplex system using a Forward Channel and Reverse Channel in accordance with the invention.

Figure 3 is a detailed view of a Forward Channel, a Reverse Channel, and a Clear Channel Assessment phase in accordance with the invention.

Figure 4 is a detailed view of a successive series of Forward Channel, Reverse Channel, and Clear Channel Assessment occurrences with Dwell Time rotation in accordance with the invention.

Figure 5 is a detailed view of a successive series of Forward Channel, Reverse Channel, and Clear Channel Assessment occurrences with two-zones in accordance with the invention.

DETAILED DESCRIPTION OF THE INVENTION

The preferred embodiments of the invention are now described with reference to the figures where like reference numbers indicate like elements. Also in the figures, the left most digit of each reference number corresponds to the figure in which the reference number is first used.

These preferred embodiments are discussed in the context of a single-point to fixed-multipoint wireless data communication in an Internet Protocol Multiple Access (IPMA) system. The invention, however, can be practiced to provide information (*e.g.*, data, digitized voice) for a wide range of Internet applications (*e.g.*, e-mail, various Internet applications, etc.). For example, a single-point station can provide Internet connectivity services to the various fixed-multipoint stations to enable users at these multipoint stations to send and receive e-mail, connect with the World Wide Web, or establish digitized voice communications. Moreover, the invention can be practiced in other applications and embodiments as would be apparent to one skilled in the art. For example, the teachings of the invention can be used in a non-wireless communication medium, such as a copper-based or fiber optics-based communication medium. One such embodiments of the invention, can be a local area network having a single-point to fixed-multipoint topology.

Figure 1 is a topological view of a single-point to fixed-multipoint wireless data communication system **100** in accordance with the invention. System **100** includes a Base Station **102**, and a plurality of Remote Stations **104**. Communication from and to Base Station **102** and each of the Remote Stations **104** is provided over a Forward Channel (FC) **106** and a Reverse Channel (RC) **108**, respectively. In this embodiment, FC **106** and RC **108** are modulated over carrier signals in the 2 GHz frequency range. As would be apparent to one skilled in the art, other types of modulation techniques and carrier signals can be readily utilized with the invention. In this embodiment, Base Station **102** provides an Internet connection and data (*e.g.*, e-mail) can be downloaded to the Remote Stations **104**, via FC **106**, and Remote Stations **104** can upload data via RC **108**.

The communication between Base Station **102** and each Remote Station **104** can be conducted with a half- or full-duplex embodiments. Figure 2A is a high level view of

a half-duplex embodiment **200** of the invention. In this embodiment, Base Station **102** first transmits to each Remote Station **104** via FC **106**. During this time interval, each Remote Station **104** tunes (switches) to the frequency of FC **106** and receives data packets (or data packet) transmitted by Base Station **102**. The time interval allotted for FC **106** is based, in part, on the time requirements for Base Station **102** to transmit (or burst) data and each Remote Stations **104** to receive the data.

Base Station **102** can dynamically communicate with Remote Stations **104** in a number of different addressing schemes. For example, for each FC **106,** data packet can be destined for a specific Remote Station **104**, all Remote Stations **104**, or a subset (pre-assigned group) thereof. Data packets destined for a specific Remote Station are marked by a unique address that is assigned *a priori* to each Remote Station **104**. In such an instance, each Remote Station **104** detects FC **106**, but only the Remote Station with a matching address will process the received data and the remaining Remote Stations **104** will discard the transmitted data packets. Data packets destined to all Remote Stations **104** are marked by a broadcast address. Upon detection of FC **106**, each Remote Station **104** will recognize the broadcast address and process the received data. Data packets destined for a subset of Remote Stations **104** are marked by a special address, thereby providing a semi-broadcast type of communication.

The foregoing addressing scheme of the invention can be readily mapped into higher level protocols, such as the widely used Internet Protocol (IP). In such an embodiment, the address of each Remote Station **104** can correspond to the IP address of that Remote Station **104**. Alternatively, the Remote Station IP address itself can be used directly within the addressing scheme of embodiments of the invention. The advantage of this later embodiment is the elimination of added complexity of mapping and the easier interface to the Internet, or other IP networks, via the Base Station **102**. Moreover, in such IP embodiments, existing higher level networking communication software and hardware can be utilized with the invention. For instance, data packets that are meant to be sent to all Remote Stations **104** can use the default addressing broadcast scheme of IP. These types of data packets can include control data that can be used for overall system management, provisioning, control, or merely to broadcast user information to the Remote Stations **104**. Data packets that are meant to be sent to a specific Remote Station **104** will have the IP address of that specific station. Accordingly, only that specific

Remote Station will unpack that data packet at its networking layer while all other Remote Stations **104** will simply discard that packet. Another advantage of using the IP protocol, as an addressing scheme, is the ability to create zones that correspond to one or more sub-networks of the IP network. Accordingly, such embodiments of the invention can be configured so that a subset of the Remote Stations **104** exist in one IP sub-network or zone.

Returning to Figure 2A, once the time allotted for FC **106** has expired, each Remote Station **104** switches to listen to the frequency of RC **108** and enters into a Clear Channel Assessment (CCA) **202** phase. During this time, each Remote Station **104** listens to RC **108** to ascertain whether other Remote Stations **104** are transmitting. If a first Remote Station, which has data packets to send to Base Station **102**, ascertains that none of the other Remote Stations **104** are transmitting, the first Remote Station transmits its data packets to Base Station **102** until the time allotted for RC **108** expires. Since each Remote Station **104** listens to all transmissions originating from any other Remote Stations **104**, each Remote Station **104** detects the transmission of the first Remote Station and refrains from transmitting. Further discussion of these features of the invention is provided below. Once the time allotted for RC **108** expires, all Remote Stations **104** switch their listening frequency again to re-tune to FC **106** and Base Station **102** begins to transmit another occurrence of FC **106** to Remote Stations **104**.

In accordance with the invention, each Remote Station **104** thereby determines whether or not to transmit data (by monitoring the RC **108**). In this regard, the embodiments of the invention do not require Base Station **102** to broker or provide access to RC **108** among Remote Stations **104**. Accordingly, any propagation delay associated with the brokering is circumvented.

To facilitate the requisite handshaking and low error rate communication between Base Station **102** and Remote Stations **104**, these stations are synchronized. Methods for synchronizing communication systems are well known in the art and can be readily employed with the embodiments of this invention. For example. synchronization can be achieved during the initial configuration of system **100** and can be maintained by broadcast control packets transmitted from Base Station **102**.

The invention also provides Guard Times (GT) **204** to accommodate for delays associated with embodiments thereof and to optimize each embodiment to specifications of that embodiment (*e.g.*, extremely low error rate, minimized synchronization time, etc.). As noted before, the invention can be practiced, with various applications, topologies, and station designs. Each embodiment will require the compensation for propagation delays associated with FC **106** and RC **108** transmissions (a function of the distance between the stations) and delays associated with the circuitry (hardware), processing, and frequency switching of the stations. It would be apparent to one skilled in the art how to calculate or measure such delay times.

In the present embodiment, GT **204** are placed at the beginning and end of FC **106**, RC **108** and CCA **202**. Other GT **204** arrangements, however, can be used to accommodate for aforementioned and other delays. For example, an embodiment of the invention can have GT **204** placed at the beginning and at the end of FC **106**, at the end of RC **108**, and at the end CCA **202**.

Figure 2B is a high level view of a full-duplex embodiment **206** of the invention. The main difference between this embodiment and the aforementioned half-duplex embodiment is that the transmission of FC **106** overlaps with the transmission of RC **108**. The transmission of FC **106**, however, does not occur during the CCA **202** phase of RC **108.** Accordingly, the transmission of FC **106** begins after the expiration of the time allotted for the CCA **202** phase. As illustrated in Figure 2B, FC **106** can last for a period that equals the time remaining for the RC transmission **108**. As with half-duplex embodiments of the invention, full-duplex embodiments can utilize GT **204** to accommodate for various delays.

Figure 3 is a detailed view of FC **106**, RC **108**, and CCA **202** and illustrates the operation of a full-duplex embodiment of the invention **300**. Initially, Remote Stations **104** are tuned to listen to the frequency of FC **106**. After the time allotted for FC **106** expires, each Remote Station **104** re-tunes to the frequency of RC **108** and begins to listen to this channel. This marks the beginning of the CCA **202** phase.

In this embodiment, CCA **202** is divided into periods of time, Dwell Time (DT) of equal time duration. However, other embodiments of the invention can use DT of various time durations. As illustrated in Figure 3, in there are "n" DT periods (*e.g.*, DT_1 **302**, DT_2

304, and DT_n **306**). In general, each Remote Station **104** is dynamically assigned a particular DT period and listening occurs in a serial manner. Each Remote Station **104** listens to RC **108** during its designated DT and if during its DT the channel clear, that station can transmit data. More specifically, during the CCA **202** phase, each Remote Station **104** waits until its assigned DT to listen RC **108.** A first Remote Station (*e.g.,* a Remote Station designated an identification (Id) of one) with DT_1 **302** listens first to RC **108**. After the expiration of DT_1 **302**, a second Remote Station (*e.g.,* a Remote Station designated with an Id of two) listens to RC **108** for the period of DT_2 **304**. Similarly, an "n^{th}" Remote Station waits until the beginning of DT_n **306** to listen to RC 108 for that DT period. A Remote Stations that has data to send to Base Station **102** does so only when that Remote Station has listened to RC **108**, at its designed DT, and has ascertained that no other Remote Station **104** is transmitting (*i.e.,* that a clear channel exists). In the above example, if the first Remote Station has no data to send, that station spends DT_1 **302** listening to RC **108** and does no transmission (even if a clear channel exists).

The second Remote Station starts to listens to RC **108,** at DT_2 **304,** and assesses whether or not a clear channel condition is met. In this example, the channel is clear as the preceding Remote Station (*i.e.,* the first Remote Station) did not have any data and no other station (*e.g.,* an "n^{th}" Remote Station) has had the opportunity to transmit yet. If the second Remote station does not have data to transmit it listens to RC **108** during DT_2 **304** without any transmission over RC **108,** in the same fashion as the first Remote Station. If, however, the second Remote Station does have data to transmit it does so over RC **108** immediately after the station assesses that a clear channel is present. In accordance with the invention, the second Remote Station will transmit all its data during the time allotted for this occurrence of RC **108** or until the RC expires. Once DT_2 **304** has expired, and during DT_n **306,** the "n^{th}" Remote Station begins to listen to RC **108** and detects that the second Remote Station is still transmitting data. Accordingly, the "n^{th}" Remote Station assesses that RC **108** is not a clear channel (busy) and does not transmit any data (if it had any) during this particular RC **108** period.

In order to ensure that all Remote Stations **104** have equal opportunity to transmit data to Base Station **102**, the order of DT (*e.g.,* **302**, **304**, and **306**) must be changed during successive RC occurrences. Otherwise, Remote Stations **104** with a low order DT (in this example, the first and second Remote Stations) would always have a higher

priority to send data than Remote Stations with a higher order DT (in this example, the "n^{th}" Remote Station).

Figure 4 is a detailed view of a series of FC (**402**, **404**, **406**, **408**), RC (**410**, **412**, **414**), and CCA (**416**, **418**, **420**) occurrences with DT rotation, in a full-duplex embodiment **400** of the invention. After FC **402** and at the beginning of RC **410,** a first Remote Station listens to the channel during DT_1 **422**. Next, a second Remote Station listens during DT_2 **424** and finally an "n^{th}" Remote Station listens during DT_n **426**. The DT are then rotated in a round robin fashion for the next RC occurrence (RC **412**). As illustrated in Figure 4, during RC **412**, the Remote Station that listened last (in this example, the "n^{th}" Remote Station) will listen first, as its DT_n 426 is shifted to the beginning of CCA **418.** The other Remote stations DT are shifted to occur later in time by a period equal to DT_n. Over time of the operation the rotation provides each Remote Station **104** with an equal opportunity to transmit data. As would be apparent to one skilled in the art, assignment and the changing of DT order can readily be achieved with other algorithms other than the round robin schemes above. Equal access to the bandwidth is an important feature for those embodiments that support time sensitive traffic or require small and consistent delays. For instance, voice over IP requires not only small delays, but also consistent delay, because large variations of delay tend to cause jitter. Moreover, embodiments of the invention can be implemented with other DT structures. For example, one or more Remote Stations can be assigned a predetermined and fixed DT slot. With such embodiments, priority to certain Remote Stations can be achieved.

As noted above, the invention can be practiced with multiple zones. Figure 5 is a detailed view of a series of FC (**502**, **504**, **506**, **508**), RC (**510**, **512**, **514**), and CCA (**516**, **518**, **520**) in a two-zone (Zone 1 and 2) embodiment **500** of the invention. In this embodiment, Remote Stations **104** assigned Id addresses 1 through 100 are configured in Zone 1 and Remote Stations assigned Id address 101 through 256 are configured in Zone 2. Remote Stations, in Zone 1, transmit at a first occurrence of a Reverse Channel (in this instance, RC **510**). Remote Stations, in Zone 2, transmit at a second occurrence of the Reverse Channel (in this instance, RC **512**). Thereafter, Remote Stations, in Zone 1, transmit again at the following occurrence of a Reverse Channel (in this instance, RC

514) and so forth. In this preferred embodiment, Remote Stations within a given zone only listen to the Remote Stations in their zone.

In this preferred embodiment, the changing of the DT order occurs independently in each zone and the rotation scheme disclosed above is utilized. Accordingly, DT associated with Remote Stations in Zone 1 (in this instance, DT_1 **522** through DT_{100} **524**) are rotated at each Reverse Channel in which Zone 1 Remote Stations can transmit (in this instance, RC **510** and RC **514**). Correspondingly, DT associated with Remote Stations in Zone 2 (in this instance, DT_{101} **526** through DT_{256} **528**) are rotated at each Reverse Channel occurrence such stations are assigned to transmit (in this instance, RC **512**).

The use of zones allows for the grouping of those Remote Stations that are close in proximity to each other. The transmission hardware (*e.g.,* antennas) of Remote Stations is thus kept at a minimum because each Remote Stations only has to listen to those Remote Station in its assigned zones. In addition, such embodiments of the invention allow the maintenance of a single Base Station in a spacious geographical area while minimizing the cost of the hardware at the Remote Stations due to their grouping in zones of smaller geographic areas.

Alternatively, Remote Stations can be grouped in zones that correspond to a type of service. Because the changing of DT occurs for each zones independently, those zones having fewer Remote Stations have a higher access rate for each of their Remote Stations. For instance, Zone 1 in Figure 5 has 100 Remote Stations while Zone 2 has 155 Remote Stations. Thus, the DT of each Remote Station in Zone 1 is rotated at a faster rate than DT of a Remote Station in Zone 2. Accordingly, Remote Stations at Zone 1 will have a higher overall access rate than Remote Stations in Zone 2.

It would be apparent to one skilled in the art that the configuration of zones and their corresponding addresses is a matter of network design, and the methods used are well known in the art. For example, a class-C IP sub-network can be assigned to a single zone with embodiments of the invention. Alternately, IP masking can be used to assign smaller or larger IP sub-networks to zones in such embodiments.

Although the invention has been particularly shown and described with reference to several preferred embodiments thereof, it will be understood by those skilled in the art

that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A system, comprising:

a base station capable of providing a forward channel signal; and

a remote station capable of monitoring for said forward channel signal, monitoring a reverse channel during a clear channel assessment interval, and providing a reverse channel signal when said reverse channel is clear.

2. The system of claim 1, wherein said base station is capable of receiving information encoded on said reverse channel and wherein said remote station is capable of receiving information encoded on said forward channel.

3. The system of claim 1, wherein said forward channel signal and said reverse channel signal include data packets.

4. The system of claim 3, wherein said data packets include digitized voice and data.

5. The system of claim 1, wherein said forward channel includes an address.

6. The system of claim 5, wherein said remote station is assigned a unique remote station address and wherein said remote station is capable of accepting information encoded on said forward channel when said address of said forward channel matches said assigned unique remote station address.

7. The system of claim 5, wherein a remote station address is assigned a priori to said remote station.

8. The system of claim 5, wherein said address is a broadcast address.

9. The system of claim 5, wherein said address is a semi-broadcast address.

10. The system of claim 5, wherein said address corresponds with an Internet Protocol address.

11. The system of claim 5, wherein said address is an Internet Protocol address.

12. The system of claim 5, wherein said remote station is assigned a first remote station address from a first set of addresses and another remote station is assigned a second remote station address from a second set of addresses.

13. The system of claim 12, wherein said first set of address form a first zone and said second set of addresses form a second zone.

14. The system of claim 5, wherein said remote station is assigned a remote station address from a set of addresses and said set of addresses form an Internet sub-network.

15. The system of claim 1, wherein said clear channel assessment interval includes predetermined dwell times and wherein said remote station monitors said clear assessment channel during an assigned dwell time.

16. The system of claim 15, wherein each of said dwell times is of equal duration.

17. The system of claim 15, wherein said remote station is dynamically assigned a dwell time.

18. The system of claim 17, wherein said dwell times are assigned to said remote station and another remote station in a round robin fashion.

19. The system of claim 1, wherein said forward channel signal is provided during a predetermined forward channel interval and said reverse channel signal is provided during a predetermined reverse channel interval.

20. The system of claim 19, further comprising guard times among said forward channel interval, said reverse channel interval, and said clear channel assessment interval.

21. The system of claim 20, wherein said guard times are positioned at the beginning and end of said forward channel interval, said reverse channel interval, and said clear channel assessment interval.

22. The system of claim 20, wherein said guard times are positioned at the beginning and end of said forward channel interval and at the end of said reverse channel interval and said clear channel assessment interval.

21. The system of claim 1, wherein the system is an Internet Protocol Multiple Access environment.

22. The system of claim 1, wherein said forward channel signal and said reverse channel signal are wireless signals.

23. The system of claim 22, wherein said forward channel signal and said reverse channel signal are modulated signals each having carrier signals with a frequency of approximately 2 GHz.

24. The system of claim 1, wherein said forward channel signal and said reverse channel signal are each electrical signals transmitted in an electrical medium.

25. The system of claim 1, wherein said forward channel signal and said reverse channel signal are each optical signals transmitted in an optical medium.

26. The system of claim 1, wherein said forward channel signal and reverse channel signal are half-duplex signals.

27. The system of claim 1, wherein said forward channel signal and reverse channel signal are full-duplex signals.

28. The system of claim 1, wherein said base station is capable of synchronizing with said remote station.

29. The system of claim 28, wherein said base station uses broadcast control packets for synchronization.

30. A method for a single-point to a fixed multi-point system having a base station and a plurality of remote stations, the method comprising the step of:

transmitting from the base station a forward channel signal;

monitoring for said forward channel signal at each of the plurality of remote stations; and

monitoring a reverse channel at each of the plurality of remote stations, wherein each of the plurality of remote stations monitors at an assigned predetermined time within a clear assessment interval,

if said reverse channel is clear during an assigned predetermined time associated with one of the plurality of remote stations and said one of the plurality remote stations has information to send the base station, transmitting a reverse channel signal from said one of the plurality of remote stations.

31. The method of claim 30, wherein said forward channel signal has data information and address information.

32. The method of claim 31, further comprising the steps of assigning a unique remote station address to each of the plurality of remote stations and accepting said data information at one of the plurality of remote stations when said address matches an unique address of said one of the plurality of remote stations.

33. The method of claim 32, wherein said step of assigning unique remote address is done a priori.

34. The method of claim 31, wherein said address information is a broadcast address.

35. The method of claim 31, wherein said address information is an Internet Protocol address.

36. The method of claim 31, further comprising the steps of assigning a first remote station address from a first set of addresses to one of the plurality of remote stations and assigning a second remote station address from a second set of addresses to another of the plurality of remote stations.

37. The method of claim 36, wherein said first set of address form a first zone and said second set of addresses form a second zone.

38. The method of claim 31, wherein said forward channel signal and said reverse channel signal include data packets.

39. The method of claim 38, wherein said data packets include digitized voice and data.

40. The method of claim 30, wherein said predetermined time is a dwell time and said channel assessment interval is partitioned into dwell times.

41. The method of claim 40, wherein each of said dwell times is of equal duration.

42. The method of claim 40, further comprising the step of dynamically assigning dwell times to each of the plurality of remote stations.

43. The method of claim 42, wherein said dwell times are assigned in a round robin fashion.

44. The method of claim 30, wherein said forward channel signal is provided during a predetermined forward channel interval and said reverse channel signal is provided during a predetermined reverse channel interval.

45. The method of claim 44, further comprising the step of providing guard times among said forward channel interval, said reverse channel interval, and said clear channel assessment interval.

46. The method of claim 45, wherein said guard times are positioned at the beginning and end of said forward channel interval, said reverse channel interval, and said clear channel assessment interval.

47. The method of claim 30, wherein the system is used in an Internet Protocol Multiple Access environment.

48. The method of claim 30, wherein said forward channel signal and said reverse channel signal are wireless signals.

49. The method of claim 30, wherein said forward channel signal and reverse channel signal are half-duplex signals.

50. The method of claim 30, wherein said forward channel signal and reverse channel signal are full-duplex signals.

51. The method of claim 30, further comprising the step of synchronizing the base station with the plurality of remote stations.

52. The method of claim 51, wherein broadcast control packets are used for synchronization.

53. A single-point to a fixed multi-point system, comprising:

base station means for transmitting a forward channel signal; and

remote station means for monitoring for said forward channel signal, monitoring a reverse channel at an assigned predetermined time within a clear assessment interval, and transmitting a reverse channel signal wherein said means transmits said reverse channel signal after detecting that said reverse channel is clear during said predetermined time.

54. The system of claim 53, wherein said forward channel signal has data information and address information.

55. The system of claim 54, wherein said remote station means has a unique remote station address and said remote station means accepts said data information when said address information matches said unique address.

56. The system of claim 54, wherein said remote station means has a first remote station address from a first set of addresses and a second remote station means has a second remote station address from a second set of addresses.

57. The system of claim 56, wherein said first set of address form a first zone and said second set of addresses form a second zone.

58. The system of claim 54, wherein said address information is a broadcast address.

59. The system of claim 54, wherein said forward channel signal and said reverse channel signal include data packets.

60. The system of claim 53, wherein said predetermined time is a dwell time and said channel assessment interval is partitioned into dwell times.

61. The system of claim 53, wherein said forward channel signal is provided during a predetermined forward channel interval and said reverse channel signal is provided during a predetermined reverse channel interval.

62. The system of claim 61, further including guard times among said forward channel interval, said reverse channel interval, and said clear channel assessment interval.

63. The system of claim 62, wherein the system is used in an Internet Protocol Multiple Access environment.

64. The system of claim 53, wherein said forward channel signal and said reverse channel signal are wireless signals.

65. The system of claim 53, wherein said forward channel signal and reverse channel signal are full-duplex signals.

Abstract of the Disclosure

Systems and methods for single-point to fixed-multipoint communication. The invention dynamically allocates bandwidth based on traffic demands, thus providing efficient bandwidth utilization, particularly with bursty or time sensitive data traffic. A system includes a Base Station and a plurality of Remote Stations. The Base Station transmits information to the Remote Stations via a Forward Channel and the Remote Stations transmit information via a Reverse Channel. Before transmitting on the Reverse Channel, each of the Remote Stations listens (monitors) the Reverse Channel to ascertain whether any other Remote Station is transmitting. Remote Stations transmit data only when a Remote Station determines that the channel is clear. The Remote Stations listen in sequential order, eliminating the probability of collisions caused by simultaneous transmissions from Remote Stations. The data traffic is accordingly aggregated, thus providing efficient bandwidth utilization.

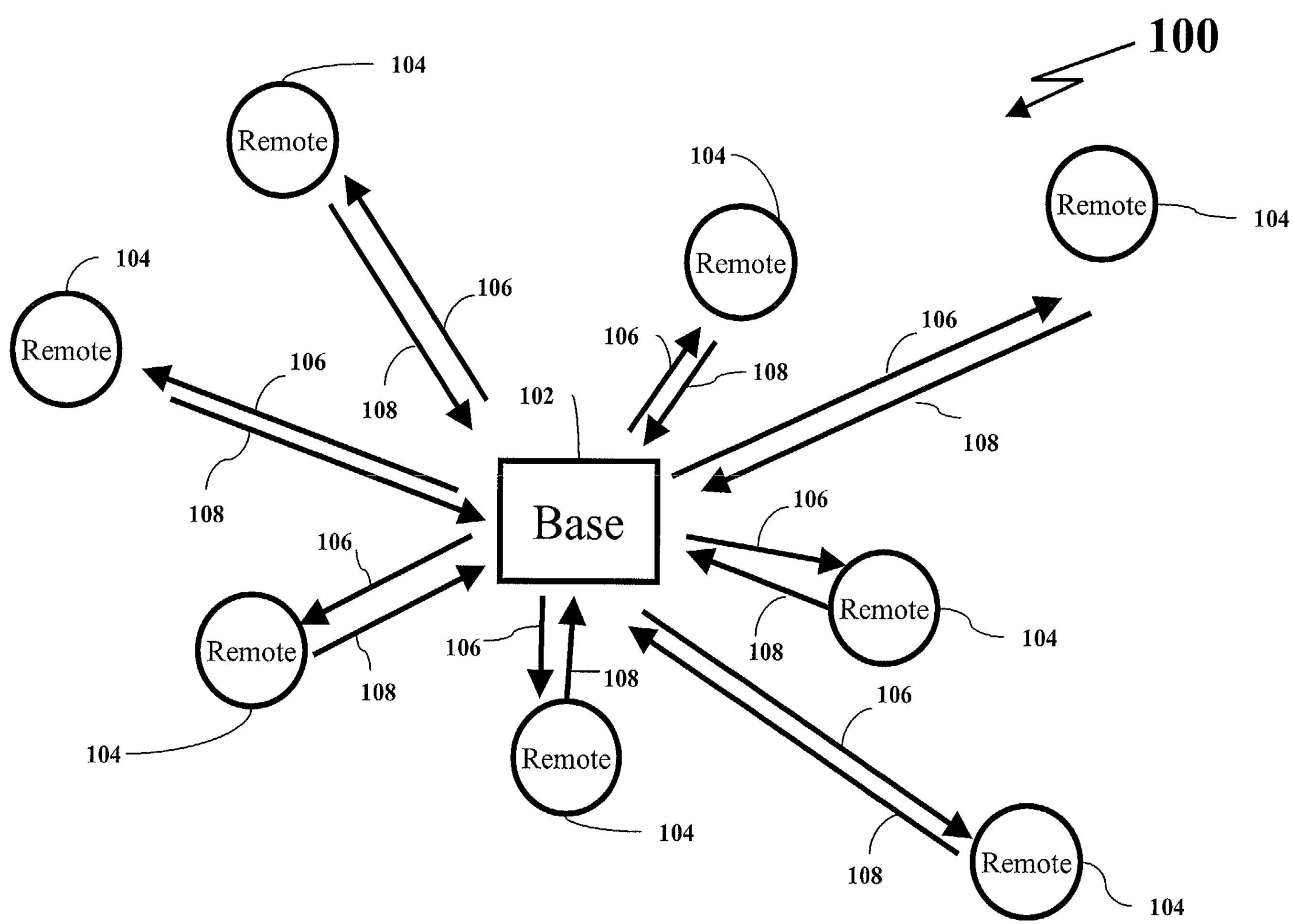


Figure 1

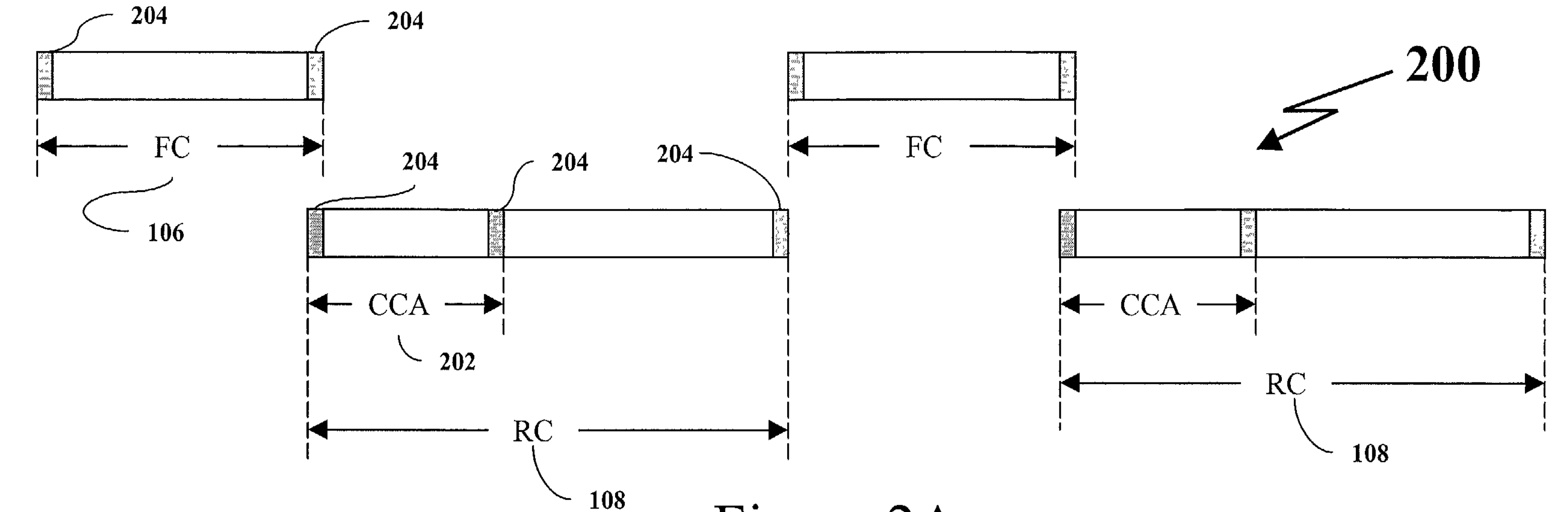


Figure 2A

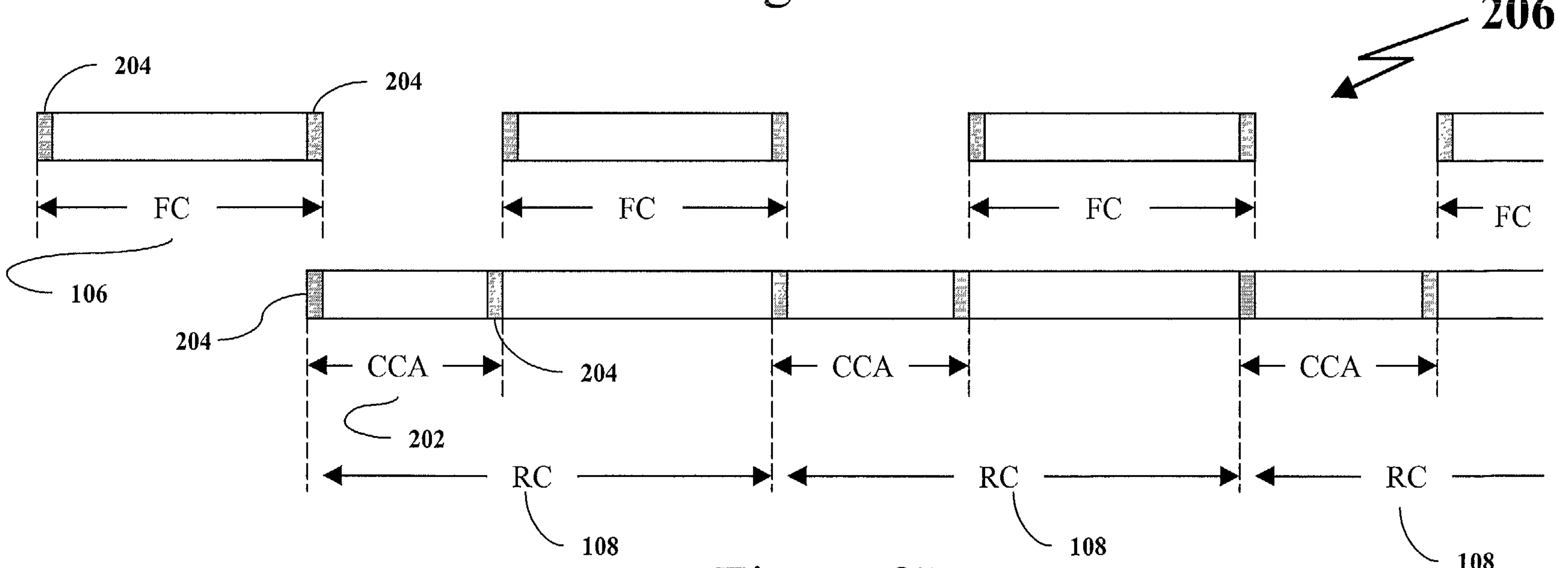
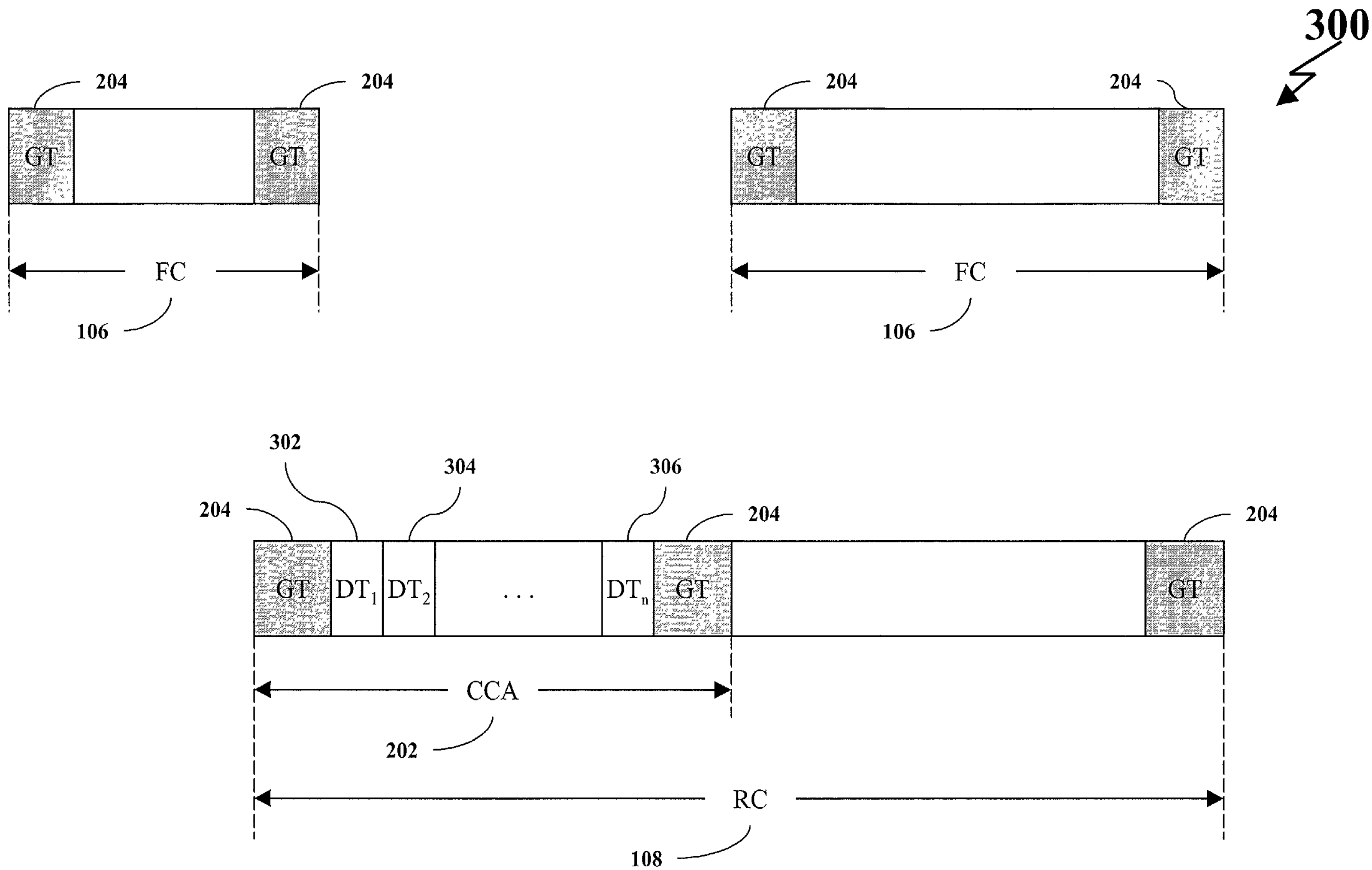


Figure 2B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FC
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204
GT
GT
FC
106
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304
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204
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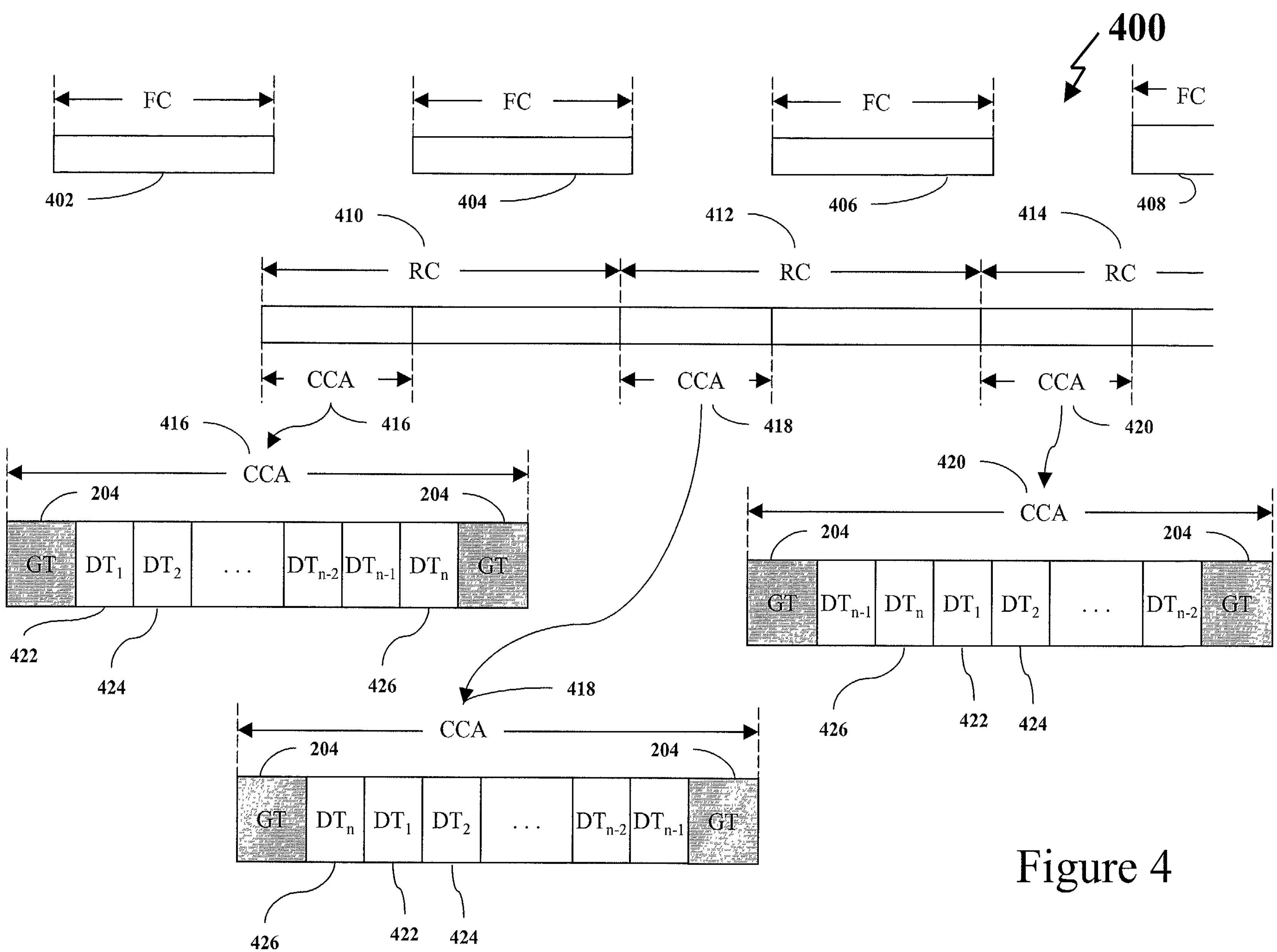
DT2
. . .
DTn
GT
GT
CCA
202
RC
108

Figure 3



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FC
FC
FC
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408
410
412
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RC
RC
RC
CCA
CCA
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418
418
420
420
CCA
CCA
CCA
204
GT
DT1
DT2
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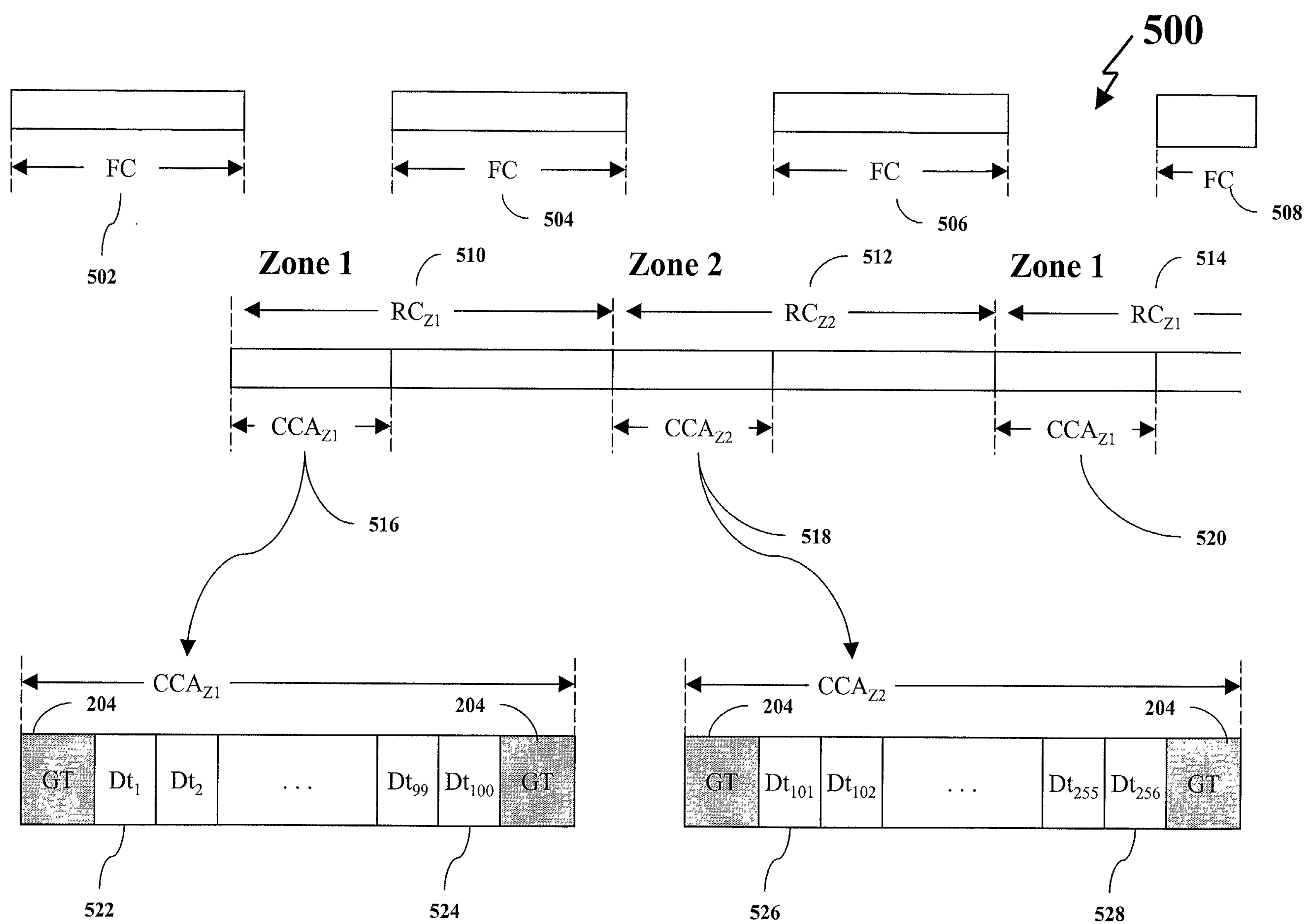
DTn-2
DTn-1
DTn
DTn-1
DTn
DT1
DT2
DTn-2
422
424
426

Figure 4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506
FC
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Zone 2
512
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CCA$_{Z1}$
CCA$_{Z2}$
CCA$_{Z1}$
516
518
520
CCA$_{Z1}$
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Dt$_{99}$
Dt$_{100}$
GT
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524
CCA$_{Z2}$
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Dt$_{101}$
Dt$_{102}$
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Dt$_{255}$
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GT
526
528

Figure 5